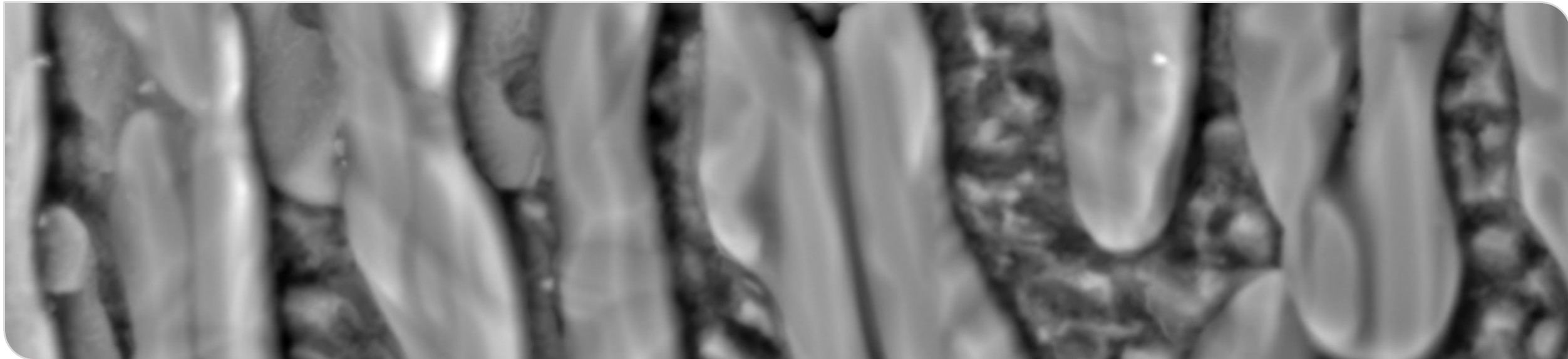


# Extracting, Mapping, Editing SEM Metadata

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MaTeLiS meeting 26.04.2023



# Metadata

From FAIR principles: *“Metadata should richly describe the data with a plurality of accurate and relevant attributes”*

How the SEM schema looks like:

```
499     "pressureDetails":{
500         "type":"object",
501         "description":"(Required) - Descri
502         "additionalProperties":false,
503         "properties":{
504             "value":{
505                 "type":"number",
506                 "default":-9999,
507                 "description":"(Required) - '
508             },
509             "unit":{
510                 "type":"string",
511                 "default":"Pa",
```

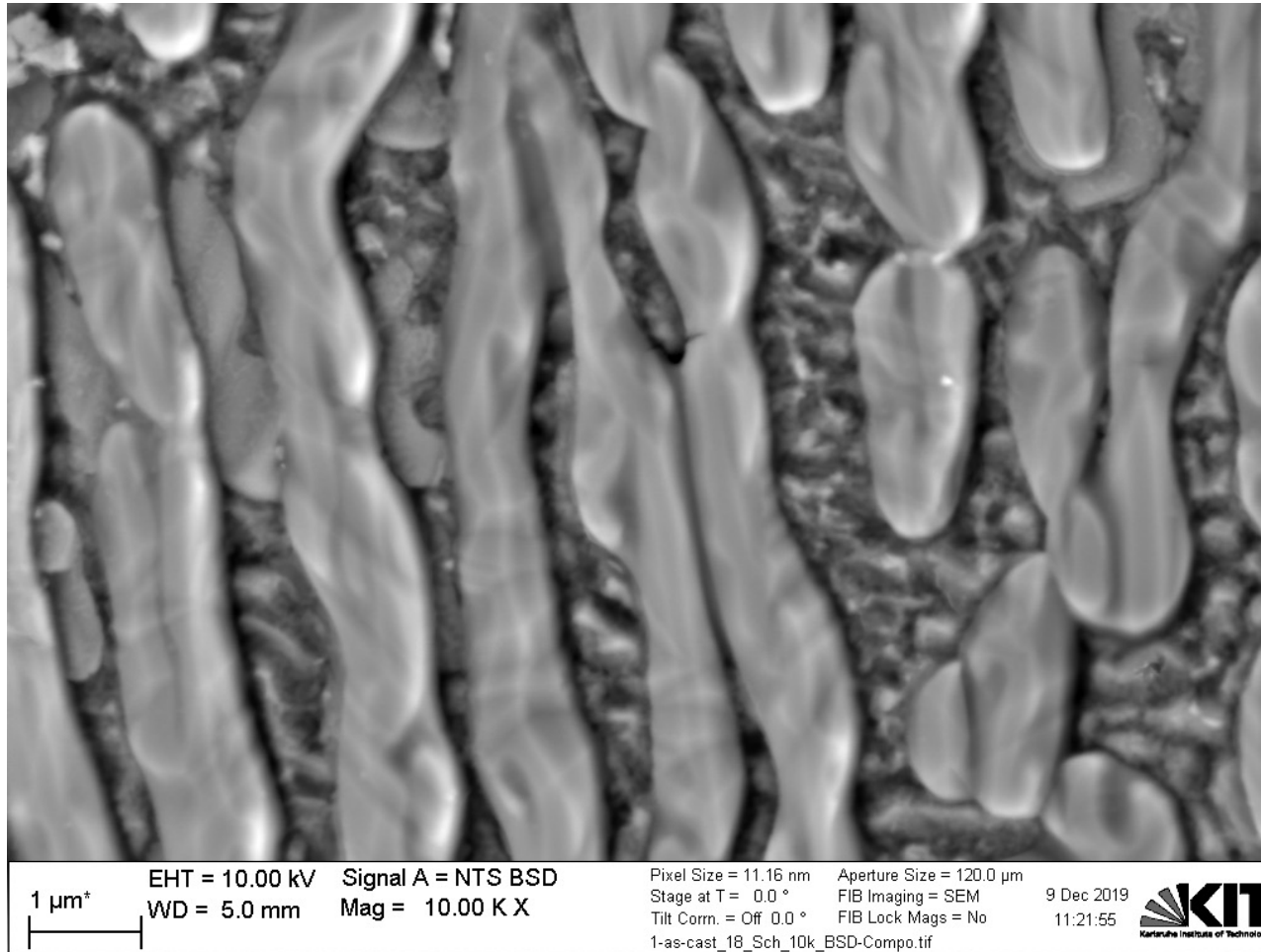
How a SEM md document looks like:

```
113     "gunPressure": {
114         "value": 0.0000000373,
115         "unit": "mbar"
116     },
117     "angleToEBeam": {
118         "value": 54,
119         "unit": "degree"
120     }
```

... Automate some steps, in order to reduce the manual work

<https://ceur-ws.org/Vol-3036/paper21.pdf>

# SEM image: TIFF file from ZEISS




Courtesy of: Sabine Schlabach

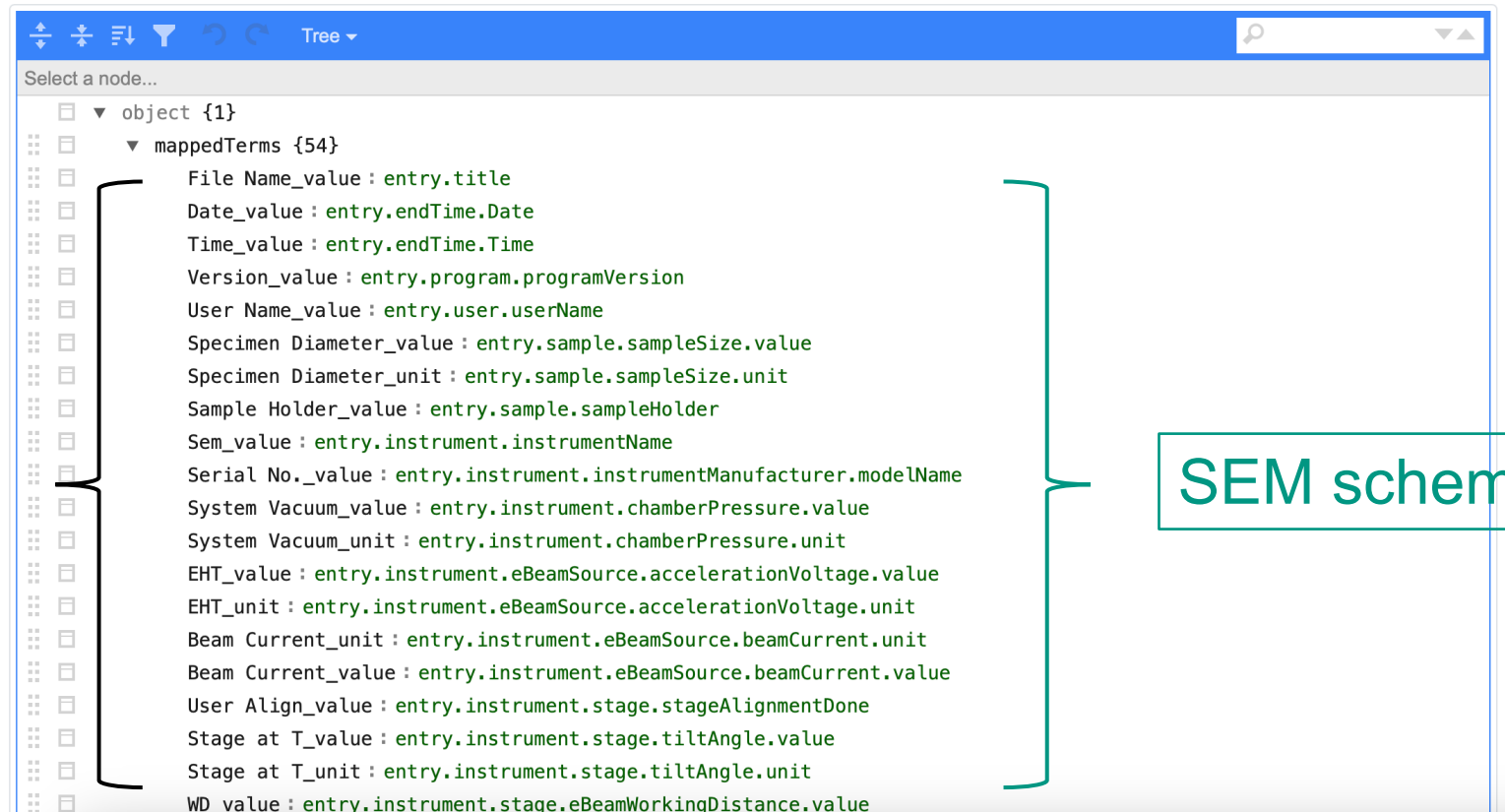
```
1455 AP_FIB_STIGMATOR_X
1456 FIB Stig X = -3.0 %
1457 AP_STAGE_AT_M
1458 Stage at M = 0.100 mm
1459 AP_STAGE_AT_Z
1460 Stage at Z = 36.853 mm
1461 AP_STAGE_AT_Y
1462 Stage at Y = 93.5093 mm
1463 AP_ACTUALCURRENT
1464 Fil I = 2.290 A
1465 AP_STAGE_AT_X
1466 Stage at X = 74.9182 mm
1467 AP_ACTUALKV
1468 EHT = 10.00 kV
1469 AP_STAGE_AT_T
1470 Stage at T = 0.0 0
1471 AP_SAMPLE_AT_Y
1472 Sample at Y = 0.0000
1473 AP_STAGE_AT_R
1474 Stage at R = 15.0 0
```

# Metadata mapping: zeiss\_to\_json

Schema Document

Choose File  map.json

Select the schema of your document.



The screenshot shows a JSON tree view with the following structure:

```
object {1}
└─ mappedTerms {54}
   └─ File Name_value : entry.title
   └─ Date_value : entry.endTime.Date
   └─ Time_value : entry.endTime.Time
   └─ Version_value : entry.program.programVersion
   └─ User Name_value : entry.user.userName
   └─ Specimen Diameter_value : entry.sample.sampleSize.value
   └─ Specimen Diameter_unit : entry.sample.sampleSize.unit
   └─ Sample Holder_value : entry.sample.sampleHolder
   └─ Sem_value : entry.instrument.instrumentName
   └─ Serial No._value : entry.instrument.instrumentManufacturer.modelName
   └─ System Vacuum_value : entry.instrument.chamberPressure.value
   └─ System Vacuum_unit : entry.instrument.chamberPressure.unit
   └─ EHT_value : entry.instrument.eBeamSource.accelerationVoltage.value
   └─ EHT_unit : entry.instrument.eBeamSource.accelerationVoltage.unit
   └─ Beam Current_unit : entry.instrument.eBeamSource.beamCurrent.unit
   └─ Beam Current_value : entry.instrument.eBeamSource.beamCurrent.value
   └─ User Align_value : entry.instrument.stage.stageAlignmentDone
   └─ Stage at T_value : entry.instrument.stage.tiltAngle.value
   └─ Stage at T_unit : entry.instrument.stage.tiltAngle.unit
   └─ WD_value : entry.instrument.stage.eBeamWorkingDistance.value
```

ZEISS terms

SEM schema terms

# Mapping Service

## Mapping-Service GUI

Home   Add mapping scheme   Show all mapping schemes   **Map a document**   REST Documentation

---

### Map a document

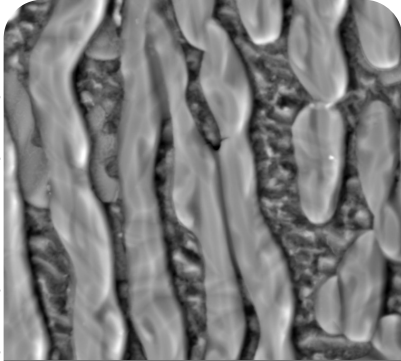
Identifier

Enter the ID of the mapping you want to use or select a mapping in the [list of mappings](#).

Document  
 1-as-cast\_18\_Sch\_10k\_BSD-Compo.tif

Select the document that should be mapped with an existing mapping.



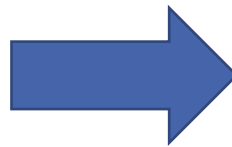
IT = 10.00 kV   Signal A = NTS BSD  
= 5.0 mm   Mag = 10.00 K X

Pixel Size = 11.16 nm   Aperture Size = 10.00 µm  
Stage tilt = 0.1°   FEI Imaging = SEM  
Ta Com = Off 0.0°   FEI Lock Magn = No   9 Dec 20  
1-as-cast\_18\_Sch\_10k\_BSD-Compo.tif   11:21

<https://metarepo.nffa.eu/mapping-service/mapDocument.html>

# Extract md and map them to SEM schema

```
1455 AP_FIB_STIGMATOR_X
1456 FIB Stig X = -3.0 %
1457 AP_STAGE_AT_M
1458 Stage at M = 0.100 mm
1459 AP_STAGE_AT_Z
1460 Stage at Z = 36.853 mm
1461 AP_STAGE_AT_Y
1462 Stage at Y = 93.5093 mm
1463 AP_ACTUALCURRENT
1464 Fil I = 2.290 A
1465 AP_STAGE_AT_X
1466 Stage at X = 74.9182 mm
1467 AP_ACTUALKV
1468 EHT = 10.00 kV
1469 AP_STAGE_AT_T
1470 Stage at T = 0.0 @
1471 AP_SAMPLE_AT_Y
1472 Sample at Y = 0.0000
1473 AP_STAGE_AT_R
1474 Stage at R = 15.0 @
```



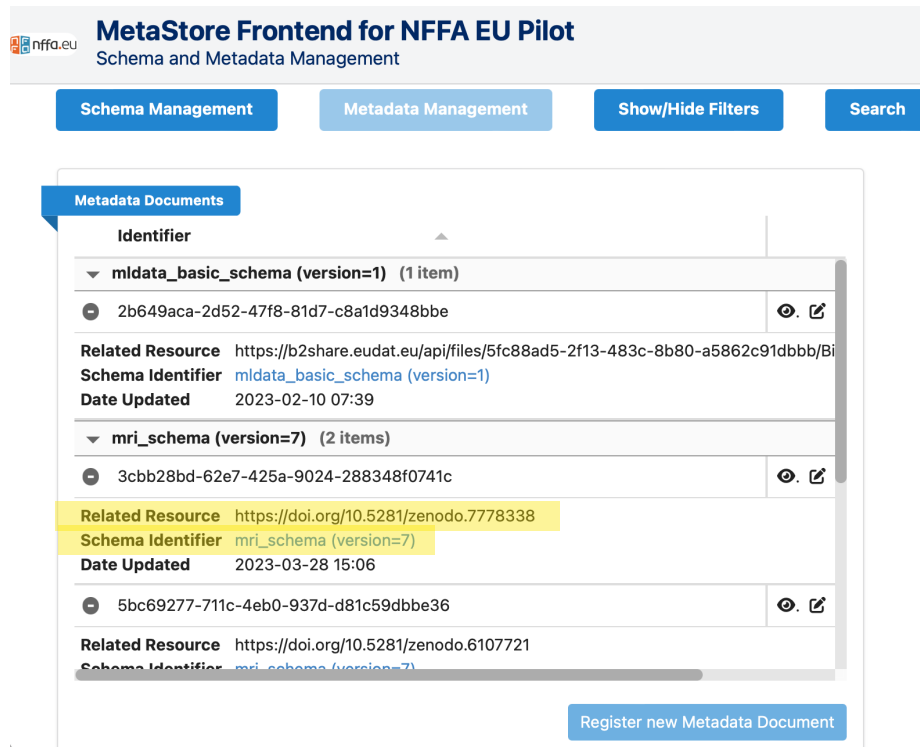
```
113     "gunPressure": {
114         "value": 0.0000000373,
115         "unit": "mbar"
116     },
117     "angleToEBeam": {
118         "value": 54,
119         "unit": "degree"
120     }
```

From md embedded in the TIFF file  
to **JSON md document**

<https://github.com/kit-data-manager/SEM-Mapping-Tool>

# What to do with a JSON md document?

From FAIR principles: *“Metadata should be registered in a searchable resource and include the identifier of the data they describe”*



The screenshot shows the 'MetaStore Frontend for NFFA EU Pilot' interface. At the top, there are navigation buttons for 'Schema Management', 'Metadata Management', 'Show/Hide Filters', and 'Search'. Below this, a 'Metadata Documents' section is visible, containing a list of documents. The first document is 'mldata\_basic\_schema (version=1) (1 item)' with identifier '2b649aca-2d52-47f8-81d7-c8a1d9348bbe'. The second document is 'mri\_schema (version=7) (2 items)' with identifier '3cbb28bd-62e7-425a-9024-288348f0741c'. The third document is 'mri\_schema (version=7)' with identifier '5bc69277-711c-4eb0-937d-d81c59dbbe36'. A 'Register new Metadata Document' button is located at the bottom right of the list.

- Register it in a md repository  
→ MetaStore (SCC-DEM)
- Validate it against the SEM schema:  
→ (At least) all the mandatory fields  
→ Not all of them are in the TIFF file!

# Edit JSON md documents

Open and edit the  
JSON file

- Tedious
- JSON skills required

```
118 |  
119 |   "sample": {  
120 |     "sampleHolder": "Carousel 8x6.5mm",  
121 |     "sampleSize": {  
122 |       "unit": "mm",  
123 |       "value": 10  
124 |     }  
125 |   },  
126 |   "title": "1-as-cast_17_Sch_10k_SESI.tif",  
127 |   "user": {  
128 |     "userName": "SABINE"  
    |   }  
    | }
```





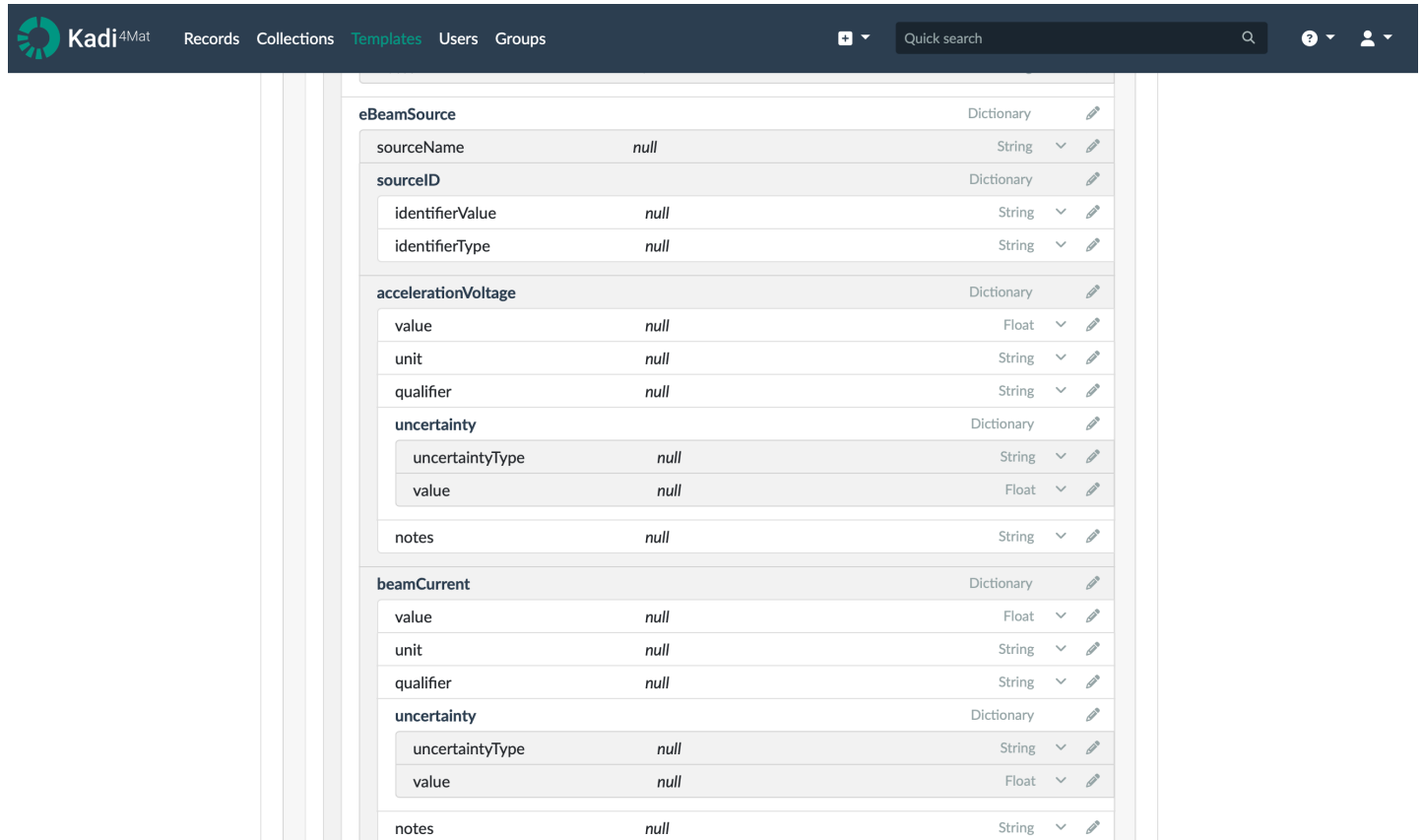
# Edit JSON md documents

Open and edit the JSON file

- Tedious
- JSON skills required

Use an ELN

- SEM Schema as template 
- JSON md document import 



Kadi<sup>4</sup>Mat Records Collections Templates Users Groups

Quick search

eBeamSource		Dictionary	
sourceName	null	String	
sourceID		Dictionary	
identifierValue	null	String	
identifierType	null	String	
accelerationVoltage		Dictionary	
value	null	Float	
unit	null	String	
qualifier	null	String	
uncertainty		Dictionary	
uncertaintyType	null	String	
value	null	Float	
notes	null	String	
beamCurrent		Dictionary	
value	null	Float	
unit	null	String	
qualifier	null	String	
uncertainty		Dictionary	
uncertaintyType	null	String	
value	null	Float	
notes	null	String	

# Edit JSON md documents

Open and edit the JSON file

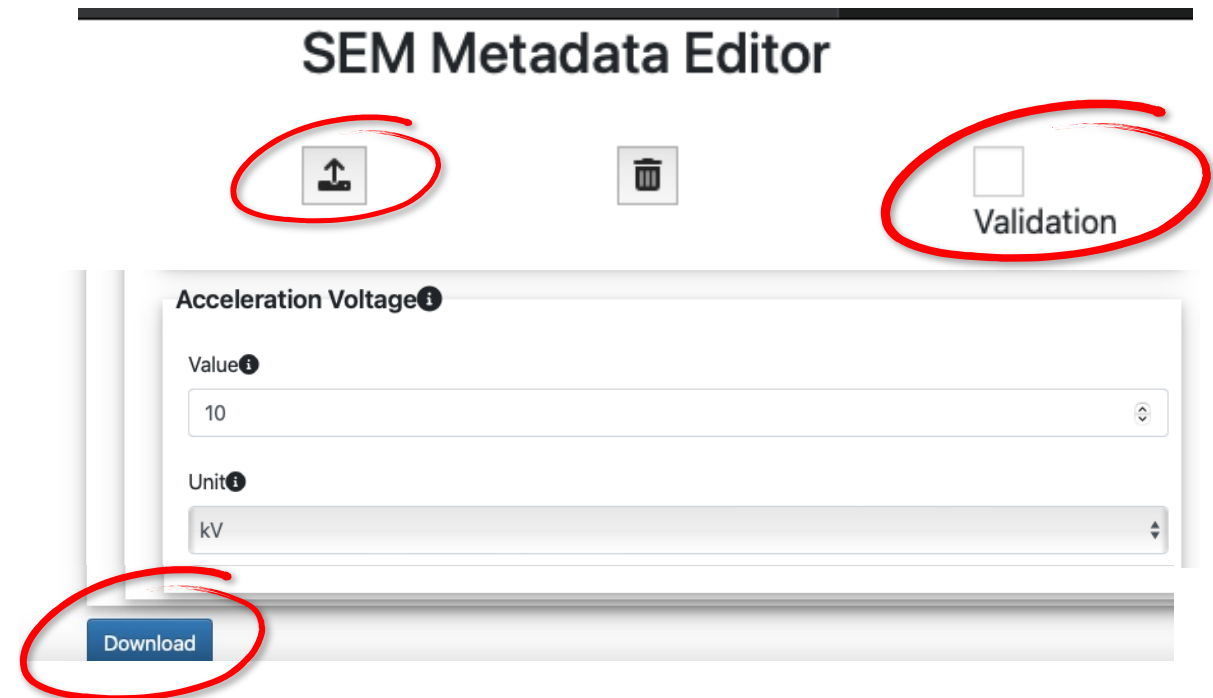
- Tedious
- JSON skills required

Use an ELN

- SEM Schema as template ✓
- JSON md document import ✗

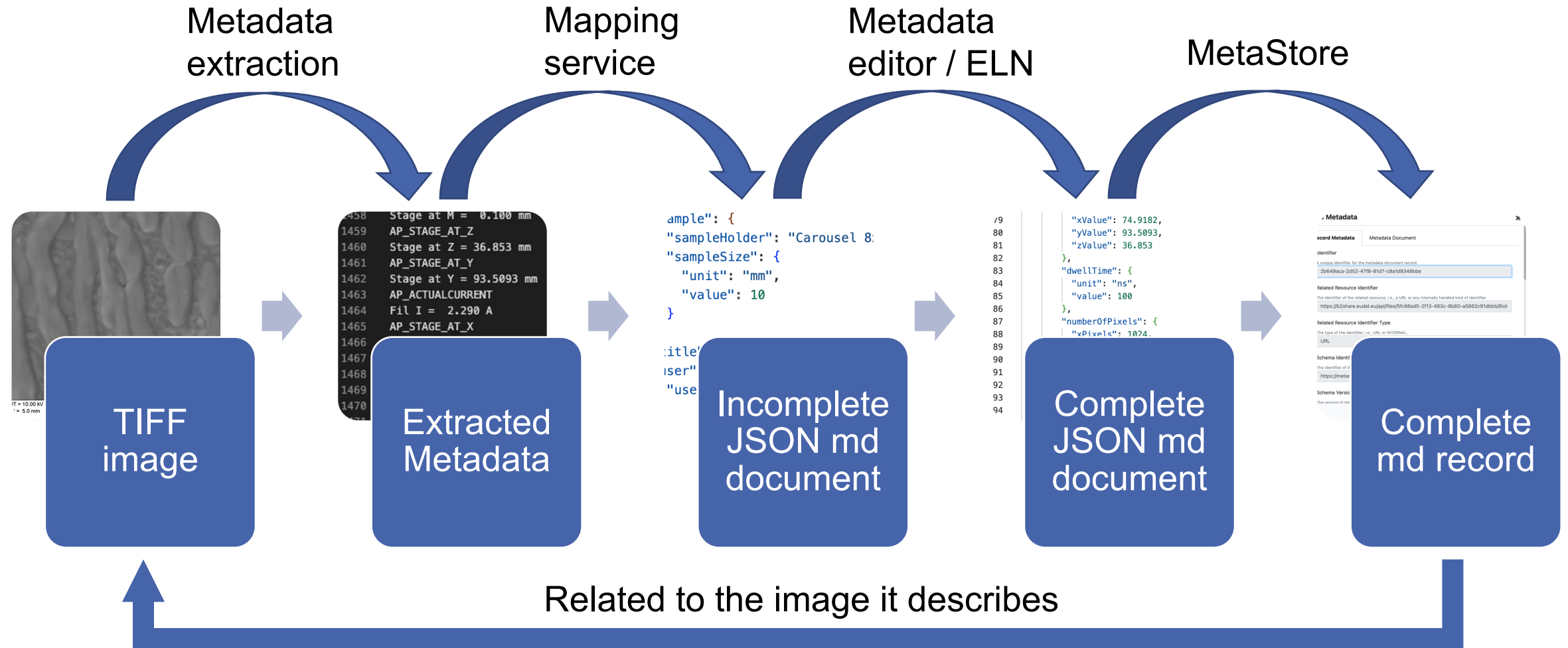
Use a custom editing interface

- Metadata Editor (SCC-DEM)



<https://kit-data-manager.github.io/Metadata-Schemas-for-Materials-Science/>

# SEM Metadata Management Workflow



# Additional Features in Development

- Add readable/workable filetype output along with JSON metadata document (csv)
- Batch processing

## Mapping-Service GUI

Home   Add mapping scheme   Show all mapping schemes   **Map a document**   REST Documentation

---

### Map a document

Identifier

Enter the ID of the mapping you want to use or select a mapping in the [list of mappings](#).

Document

Choose file   FeMoOx\_AntiA\_04\_1k5x\_CN.tif

Select the document that should be mapped with an existing mapping.

**Download result**   **Map document**

```

{
  "entry": {
    "title": "FeMoOx_AntiA_04_1k5x_CN.tif",
    "endTime": "2021-07-13T18:23:36",
    "program": {
      "programVersion": "V06.00.00.00 : 09-Jun-16"
    },
    "user": {
      "userName": "CHARLOTTE"
    },
    "sample": {
      "sampleHolder": "Carousel 8x6.5mm",
      "embeddingMaterial": "none",
      "storageConditions": "Ambient, dry environment",
      "sampleSize": {
        "value": 10,
        "unit": "mm"
      },
      "conductive": false,
      "magnetic": false,
      "eBeamSensitive": false,
      "iBeamSensitive": false,
      "conductiveCoatingApplied": false
    },
    "instrument": {
      "instrumentName": "Auriga 60",
      "instrumentManufacturer": {
        "modelName": "Auriga 60-46-18"
      },
      "chamberPressure": {
        "value": 0.00000216,
        "unit": "mbar"
      }
    }
  }
}
  
```

Title	entry.endTime	entry.instrument.FIB.FIBSpotSize.unit	entry.instrument.FIB.FIBSpotSize.value	entry.instrument.FIB.angleToEBeam.unit	entry.instrument.FIB.angleToEBeam.value
1-as-cast_16_Sch_10k_InLens.tif	2019-12-09T11:18:36	nm	979.8	degree	54
1-as-cast_17_Sch_10k_SESI.tif	2019-12-09T11:19:43	nm	979.8	degree	54
1-as-cast_18_Sch_10k_BSD_Comp.tif	2019-12-09T11:21:56	nm	979.8	degree	54
FeMoOx_AntiA_04_1k5x_CN.tif	2021-07-13T18:23:36	nm	93.89	degree	54

# New mapping service interface

More user-friendly interface in progress

## Mapping-Service GUI

[Home](#) [Add mapping scheme](#) [Show all mapping schemes](#) [Map a document](#) [REST Documentation](#)

### Map a document

Identifier

zeiss\_to\_json

Enter the ID of the mapping you want to use or select a mapping in the [list of mappings](#).

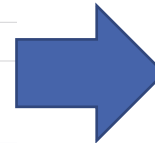
Document

Choose File 1-as-cast\_18\_Sch\_10k\_BSD-Compo.tif

Select the document that should be mapped with an existing mapping.

[Download result](#)

[Map document](#)



### Choose a Mapping

Select or search your mapping here.

Drag & Drop your files or [Browse](#)

[Map document](#)

# Benefits of the tool

## Easy to use:

- Less manual work
- Graphical User Interface

## Output JSON md document:

- Open, machine readable format
- Structured according to a md schema
- Useful to find, interpret, compare, reuse, reproduce data

## How to apply to other techniques:

- Different md schema
- Different map
- The workflow is always the same